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The life of the individual, like the history of a people, is generally divisible into a more or less well-markt series of epochs or periods. The life of Dr. Booth falls naturally into three such divisions, each quite distinct in kind, yet all animated by the same principles of intellectual acquirement, the same moral of motive, the same love of learning, the same ardor in teaching, the same activity in business, the same hearty devotion to the bettering and uplifting of his fellow-men.

The first period in the career of James Curtis Booth was his preparatory or student life. For convenience' sake, we must include here the record of his parentage and birth. He was born in Philadelphia, July 28, 1810. His father was George Booth, of New Castle, Delaware ; his mother was Ann Bolton, daughter of John and Eleanor Bolton, of Chestertown, Maryland.

After his preliminary schooling in Philadelphia and at the seminary of Hartsville, Bucks County, Pa., he entered the University of Pennsylvania, where he was graduated in 1829. He subsequently spent a year at the Rensselaer Polytechnic Institute, Troy, N. Y. But the great bent of his mind was for chemistry ; and chemistry to him was a thing beyond mere theory ; it had for him a meaning quite apart from the beauties of blackboard demonstrations and of symbolized reactions. His great thought was to find in the laboratory a miniature factory ; in the factory a mammoth laboratory. To this thoroughly utilitarian end he lookt. How fervently he cherisht this thought, how determined he was to accomplish his purpose, may be in some degree inferred from his pushing beyond the sea at a time when fashion had not yet conceived the real or nominal virtues of an education abroad. He was, indeed, the first American student in analytical chemistry who had so ventured into Germany. There being no such thing on either side of the Atlantic as a students' laboratory, he spent the year 1833 in Prof. Friedrich Wöhler's private laboratory in Hesse-Cassel. He next practiced for nine months in the laboratory of Prof. Gustav Magnus, at Berlin. The remainder of his three-year term abroad was spent in attending lectures in Berlin and in Vienna, and also in visiting various manufacturing establishments on the Continent and in England. With his return to his native city in the latter part of 1835, or early in 1836, we may consider his student or formative period (while he was in his twenty-sixth year) to have come to a close.

Obstacles to progress often become, in the end, the surest means of advancement. It was no doubt largely owing to the difficulties which Mr. Booth had to surmount that he conceived the educational scheme which was the parent of all our existing laboratories for students in applied chemistry. With the establishment of his students' laboratory in 1836 (which two years ago celebrated its semi-centennial), we may consider the second, or teaching period of our subject's career, to be fairly inaugurated. This, though the shortest of the three, was preëminently the creative period of his life.

I call it creative, because it called into being a method of technical education which has, probably more than anything else, resulted in establishing chemistry as a factor in commerce, and in gaining for the chemist a recognized position in the economy of the world's work. In fact, the students' laboratory, as instituted by Mr. Booth, bore a relation to mere class-room teaching analogous to that which the "natural method" in languages bears to the more bookish method of study by the set rules of grammar and rhetoric.

But it was no part of Mr. Booth's idea to make the laboratory course usurp the rightful position of the text-book and the lecture. He saw the great want of a supplementer rather than a supplanter. How truly he discerned what the scientific as well as the commercial world required, and how fully he met that requirement, needs no expansion here. The students' laboratories all over the country—if not beyond—as well as the throng of students who have come into and gone from his own laboratory during the past half-century—all attest the foresight, the judgment, the independence, the energy, of a scientist and a business man.

But the chemical workshop was not enough. He received an appointment from the Franklin Institute as Professor of Chemistry Applied to the Arts, in 1836 ; and during the nine successive winters (1836–1845) he delivered three courses of lectures, each course occupying three seasons. During this period, also, he filled the chair of chemistry (1842–1845) in the Central High School of Philadelphia. Nor was he wholly content with his sphere as a teacher. His studies had reacht out across and beyond the confines of his specialty into the neighboring territories of mineralogy and geology.

Concerning this field of our subject's labors, no one is so well qualified to speak as Prof. J. P. Lesley; and I am indebted to him for the following paragraphs regarding the geological surveys of Pennsylvania and Delaware. He says: "Prof. Booth and John Frazer, then a young man, were appointed by Prof. Rogers, in the spring of 1836, his two assistants in prosecuting the work of the First Geological Survey of Pennsylvania. From Spring to Fall they traveled along the Susquehanna and Juniata valleys, blocking out the order of the great formations. Prof. Booth was sent by Prof. Rogers up the Potomac to make a section which could be compared with the Juniata section; and when the three met at Huntingdon, he announced, to the astonishment of Mr. Rogers, that the mountains which fill the middle belt of Pennsylvania were made by two separate formations, now known as No. IV and No. X. Mr. Rogers was unwilling to accept this conclusion, and instructed Mr. Frazer to go to the Huntingdon-Bedford line and make a cross-section from the Broad Top coal down to the limestone of Morrison's Cove. At the end of the week the three met again in Huntingdon, and Mr. Frazer confirmed the statement of Prof. Booth. Mr. Rogers was still dissatisfied, and then went himself to repeat the section made by Mr. Frazer, finding it correct, and then accepting Prof. Booth's Potomac section. Thus the grand column of our palæozoic formations was establisht, and the credit of it is due to Prof. Booth."

Prof. Lesley adds that: "Both Prof. Rogers' assistants resigned at the end of the year; and Mr. Booth was then appointed, immediately, or not long thereafter, State Geologist of Delaware. His work in Delaware was publisht in his Report, an octavo volume, now so rare that it is impossible to obtain a copy. My belief is that Prof. Booth abandoned field work very early in his career, and devoted himself to his chemical laboratory. At all events, he is known in science altogether as an accomplisht chemist, with a great reputation for diligence and accuracy, especially in the field of mineral analysis." To Prof. Lesley's statement I may add that the Geological Survey of the State of Delaware was in Mr. Booth's charge during 1837–8; the reports were publisht as the Annual Reports of the Delaware Geological Survey (Dover, 1839), and after that he issued the "Memoir of the Geological Survey of the State of Delaware with Application to Agriculture" (Dover, 1841).

Mr. Joseph E. Hover, an old friend and co-worker with Prof. Booth, thus writes of another venture:

"In the year 1845, Prof. Booth visited Mine la Mott, a mining locality in the State of Missouri, and began the mining of cobalt, which, I think, had but recently been discovered there. After a time he had mined a large amount of cobalt, which he forwarded to England. But this enterprise proved unsuccessful, as the article was not found to be pure. The result was its reshipment to this city. In the old chemical works of the late Dr. Uhler, situated in the upper part of this city, the Professor began with his usual energy to prosecute the work of acquiring a knowledge of the best method of refining cobalt. This question of the refining of this metal was one that was obscure to all outside of the then existing cobalt refineries in the world, so the task the Professor had undertaken was one fraught with perplexing difficulty. But the effort was successful."

Mr. Booth's achievements early in his career gained him a membership in this Society, January 18, 1839. Though of recent years he seldom visited these rooms—his residence being at Haverford College—yet he always had a warm spot in his heart for the associations of our venerable hall, and a true regard for the honor of a seat upon this floor.

He contributed to the Transactions, N. S., VIII, p. 185, in connection with Prof. Martin H. Boyé, a paper on the Conversion of Benzoic Acid into Hippuric Acid.

These ventures into the field of scientific literature were enlarged by Reports from the Franklin Institute Committee on Science and the Arts, which were of Prof. Booth's writing; by a report on "Recent Improvements in the Chemical Arts," published by the Smithsonian Institute in 1852; and by his most conspicuous effort in literature, well known as the "Encyclopædia of Chemistry" (Phila., 1850). This was written chiefly by himself. Dr. Campbell Morfit rendered much assistance, however, on the last half of the work; and Prof. R. S. McCulloh contributed articles on Electricity and the Hydrometer, while Dr. Boyé contributed articles on Alcohol Analysis, and some other subjects.

This brings us to the close of the second period. As an instructor, Mr. Booth seems to have had unusual success. Dr. Alexander Mucklé, for some years past an assistant to the Melter and Refiner of the Mint, an early pupil of Mr. Booth, and subsequently himself a student under Wöhler and under Bunsen, says: "With this experience of teachers and means of comparison, I can say that Mr. Booth had few if any superiors as a teacher of practical chemistry, that he kept abreast of the times by constantly securing the best and latest scientific books and periodicals." But testimony of this sort is barely necessary. A course in his laboratory, says the *Scientific American*, "was considered necessary for the chemist of that time, and was regarded of more value than a college diploma." * * * "This institution soon acquired considerable distinction, * * * and during the course of a few years nearly fifty students availed themselves of his instruction, most of whom have since acquired distinction." It would be interesting, if it were possible, to calculate the influence that through them he has wielded and still wields upon the vast manufacturing and economic interests of a busy world.

The third period begins and ends with Prof. Booth's official life. Through his friend, Secretary Meredith, the office of Melter and Refiner of the Mint was placed at his disposal, and the appointment was made by

President Taylor. Prof. Booth assumed the duties of office, December 10, 1849. "The date," says Mr. Robert Patterson, "was nearly coincident with the discovery of gold in California, and the pressure of deposits from that source had already become heavy.

"The gold reacht the Mint for the most part in its native state, and required intricate and at the same time accurate and prompt metallurgic treatment to fit it for coinage. In one particular the Mint was ill prepared to sustain the pressure brought to bear upon it. The California gold being naturally alloyed with silver in excess of the amount admissible in the coinage, it was necessary to extract the superfluous metal by chemical treatment. The appliances at the Mint, which had proved sufficient to treat bullion received anterior to the California discoveries, were quite inadequate thereafter. It was necessary to reconstruct the whole plan of the parting apparatus, and this work devolved upon Mr. Booth. Under his supervision a process which had before been little more than one of the laboratory expanded into that of a manufactory. To this work, as well as to all the other labors of his department, he brought the full knowledge of theory and practice derived from former professional experience, and further showed, what is not always the case with chemists, a capacity to apply his knowledge in the larger way required for commercial results. Some little impatience at the delay in introducing the needful changes had been exhibited by bullion dealers and others, ignorant of the obstacles attendant thereon ; but all difficulties were overcome, and the parting (or refining) capacity of the Mint was soon, under Mr. Booth's energetic and capable management, enlarged to meet promptly every demand. This time of trial, at the very outset of his Mint career, proved the man and the officer."

There were, naturally, many trying times during the long years that followed the California gold discovery ; there were periods of changes in the coinage, changes in method, changes in administration ; there were periods of extraordinary losses through the nature of the bullion, as well as from other causes ; there were the annual settlements, the annual trials of the pyx, and trials less than annual and more than annual of the nerves of the operative officers—trials such as only devoted servants of a soulless government can understand. But there were many matters of new interest, new study, new relations, new processes to try, to lighten the burdens, relieve the tedium, and divert the mind from a wearying and exhausting sense of its peculiar responsibilities.

A paragraph from Mr. W. E. DuBois's sketch of Mr. Jacob R. Eckfeldt, then Chief Assayer, is in place here as an illustrative bit of history :

"The gold pressure continued for about five years, when it was relieved by the creation of a Government Assay Office in New York, and a Branch Mint at San Francisco. But directly sequent to this came the change of standard in silver coin, causing an immense recoinage in small pieces. Thus our daily assays continued to count by hundreds. This lasted for some years. When it began to slacken off, a law was passed for calling in the large copper coins, and issuing in their stead pieces of copper-nickel alloy of much smaller size. After this came the substitution of the bronze alloy ; and this called for another process of assay, and brought us a great deal of work."

Among the later improvements in process adopted by Prof. Booth was that of gold-refining. In his letter to the Wastage Commission he says : "I refine usually to 993 and 995 m. and sometimes, to make a finer gold, I heat the alloy of gold and silver with parting acid, so as nearly to separate them, and then heat the residue with oil of vitriol and saltpetre, at a steam heat, by which I have brought the gold to 998 m. The process is my own, and not known outside the Mint." In a paper read before the American Chemical Society and publisht in their Journal (Sept., 1884), he describes some methods of toughening gold and silver. In the same publication (June, 1884), he describes "A General Method of Toughening Gold and Silver in the Melting Crucible ;" and in June, 1885, he printed, in the same Journal, an article on "The Smelting Furnace of the U. S. Mint." At the risk of seeming too technical, I venture to quote a characteristic paragraph from the latter article. "My last improvement, which is still practiced, consists in the very simple operation of melting all the iron residues from the furnaces, even including grate-bars, and keeping them in a quiet melted state, so as to allow the heavier gold and silver to settle out of the iron. When the mass is cold, the precious metal is knockt off the bottom by a hammer as a single tough king, with scarcely a trace of iron in it ; while the iron mass above it has never yielded a trace of gold or silver to the assayer. Instead of spending three weeks, of annual vacation from melting, in hammering tons of accumulated iron, we now melt through the year, whenever convenient, from five to fifty pounds of iron residues at a time. We gathered in one melting, last autumn, a cake of a few ounces of gold and silver from a mass of over fifty pounds of iron in part of a day, and the latter was entirely free from the precious metals. When I first succeeded with this process, I could hardly believe in the perfect separation from iron, and the late Mr. J. R. Eckfeldt, the best assayer in the United States, doubted it, until, by numerous tests made from a piece of some thirty pounds of iron, he found the total absence of gold and silver." It is just to add that Prof. Booth was greatly aided by suggestions from his foreman, Mr. Garrigues, in perfecting this process.

Prof. Booth was a man of varied interests, and of large general culture. He was especially fond of linguistic studies ; and in this domain he long ago made a specialty of phonetics, particularly with reference to shorthand writing, and the reform of English orthography. He took up the study of Isaac Pitman's Phonography, which he pursued with ardor until he mastered it. This of course was more of an achievement forty years ago than it is now. He formed the opinion that this art should be acquired as one of the elementary branches of education. In his judgment, an obstacle to that end lay in the unsatisfactory form of the books of instruction provided for the study. He therefore determined to prepare an elementary work designed to teach the art, and, in 1849, this was publisht under the title, "Phonographic Instructor; being an introduction to the Corresponding Style of Phonography, with engraved illustrations." This was republisht with a Key in 1850, and again in 1856. The book was based on the inductive method, and an especial merit apart from the clear exposition of principles was in its set of progressive exercises so arranged that nothing once learned had to be unlearned, thus avoiding the discouraging confusion incident to the study as commonly taught. The book was successful, and proved the capacity of its author in elementary instruction.

That Prof. Booth was highly esteemed in social and religious as well as scientific circles is attested by the diversity and duration of his memberships, no less than by his honorary degrees. In 1867 the University of Lewisburg conferred upon him the degree of Doctor of Laws; and, in 1884, the Rensselaer Polytechnic Institute added the Ph.D. to his name. In addition to his memberships already mentioned, he was elected to the Pennsylvania Horticultural Society, in 1842; to the Academy of Natural Sciences, in 1852; to the Maryland Institute for the Promotion of Mechanic Arts, in 1853; to the Philadelphia Society for Promoting Agriculture, about 1859; to the Historical Society of Pennsylvania, in 1884. He was President of the American Chemical Society of New York, in 1883 and in 1884, and declined reëlection for a third term—that honor never having been offered to any of his predecessors. He was Assistant Secretary of the Diocese of Pennsylvania from 1865 to 1871. He was actively interested in various philanthropies. He was one of the Building Committee of Christ Church Hospital. With him and Mr. Joseph E. Hover originated the Seamen's Floating Church of the Redeemer, now on *terra firma* at Front and Queen streets. He was also an active mover in the Children's Hospital connected with the Free Church of the Good Shepherd, at Radnor, Pa.

In addition to the publications already mentioned, Prof. Booth publisht papers "On Beet Root Sugar" (1842); "Chrome Iron Analysis" (1842); "Constitution of Glycerin and Oily Acids" (1848); "Recent Improvements in the Chemical Arts" (1852), and a "Report on the Water Supply of Philadelphia" (1862). He is better known, however, as the editor and annotator of a translation from the French of Regnault's "Elements of Chemistry" (2 vols., Phila., 1853).

Prof. Booth was married November 17, 1853, to Margaret M. Cardeza. His widow and three daughters survive him. Personally, he was a gentleman of refined manners, pleasing address and cheerful disposition. The latter quality was, however, often obscured by his nervous intensity; and a painful anxiety seemed of late years to be ineradicably scored into his very life. His great responsibilities in exact manipulation of millions and millions of dollars in all forms of bullion, for whose safe custody he was also legally accountable, told heavily upon his physical constitution, and left him, long ere the year of his death, a wreck of his former self. Indeed, his noticeable failure dates from the great "wastages" of 1872, together with subsequent difficulties in the recoinage of seventeen millions of our own gold coin in 1873.

The unusual developments in this remelting, the difficulty of obtaining homogeneity, led Prof. Booth to conclude that gold-copper alloys were unstable and subject to segregation. This was contrary to all past experience; and it is due to the scientific world to say that the theory was never accepted in the Assay Department nor (I believe) by the leading experts in the sister Mints of this country. Subsequent experiments show that Prof. Booth's conclusions were based upon a misapprehension. The instability of standard gold-copper alloys has never yet been apparently demonstrated, much less proved; and the theory must be regarded as untenable. But the difficulties alluded to were none the less harassing to the Melter and Refiner, and they workt upon him disastrously.

It is often asserted that the civil service is a bed of roses. But Prof. Booth's shattered constitution and rapid decline, while yet apparently possessed of right to vigor and power, are but another witness to the peculiar wear and tear upon the minds and bodies of many public servants who honor their calling and give dignity and character to their positions. For two or three years past he had seriously contemplated resigning his office; but it was not until August, 1887, that he could bring himself to sever the attachments of thirty-nine years.

Since writing this, a private letter has been shown to me, written by Dr. Booth in October last. I make a few extracts, as follows: "The whole truth is, that the constantly increasing business of the Mint beyond its capacity for bullion storage has been increasingly weighing down my anxious thoughts for its safety, and you may add to that the consciousness that I was personally responsible for every ounce of bullion received, and then you will readily perceive sufficient ground for a constant anxious care, which I sometimes imagined to be as the square or cube of the extra quantity of bullion continually poured in. * * * It was that constant and constantly augmenting ounce-for-ounce responsibility that finally affected my mind, and I rather think broke me down. I went home quite sick from the Mint early in April, and lay on my back for about three months. I suppose that such a statement will be quite sufficient to explain my present position. I am glad to say that I had sufficient strength to resign from my place in the Mint, although no one is yet appointed to take my place. However, I do not go more than once a week to the Mint, and shall be glad when the string of union is severed. * * * From my age, over seventy-seven, I hardly expect restoration of full strength, and am satisfied with what Providence designs."

His resignation was to take effect on the appointment of his successor. But an office demanding such high trust as well as technical knowledge and practical experience was not easy to fill; and before a successor had been found, Death, on March 21, 1888, struck Dr. Booth's name forever from the roll.

He died peacefully. Faith lightened the burden of the last days of a career that has left a name worthily interwoven with the great fabric of the world's onward and upward progress.